Citation:

Redmond EC, Griffith CJ, Slader J, Humphrey T. Microbiological and observational analysis of cross contamination risks during domestic food preparation. *Brit Food J*. 2004; 106: 581-597.

Study Design:

Cross-sectional, before-and-after study, home kitchen videotaped study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To use observational data in conjunction with microbiological isolations of *Campylobacter* and *Salmonella* to determine and analyze risk factors contributing to cross-contamination during domestic food preparation and identify suspected exposure routes.

Inclusion Criteria:

- A literature review was conducted to identify vulnerable population groups to study
- Older adult aged more than 60 to 75 years
- Mothers with children aged less than 10 years old
- Single male adults (aged 18 to 28 years).

After age criteria was met, the following criteria were added:

- Frequent preparation of meals
- Regular handling of raw meat and poultry.

Exclusion Criteria:

None listed.

Description of Study Protocol:

Recruitment

Telephone recruitment interviews were undertaken by a local market research agency to screen potential participants for suitability.

Design

- Cross-sectional (observational) for food preparation by participants
- Before-and-after study for microbial sampling of model domestic kitchen before and after

food preparation by participants.

Blinding Used

Quasi-blinding: Participants were aware that they could be videotaped but unaware that their food hygiene habits were the subject of observation. If participants enquired regarding the use of the video cameras, they were informed that the cameras were in operation.

Intervention

- Comparison groups (based on consumer group):
  - Older adult more than 60 to 75 years of age
  - Mothers with children aged less than 10 years
  - Single male adults (aged 18 to 28 years)
- Microbial analysis: Suspected routes of cross-contamination using observational data.

Statistical Analysis

- Food safety behaviors implemented during food preparation sessions were observed using CCTV and recorded on detailed observational checklists
- Behavioral malpractices were scored using a risk-based scoring system developed by Griffith et al (1999) and Redmond (2002) to enable quantitative assessment of food safety behaviors
- Demerit risk scores based on recent epidemiological data were allocated to food-handling malpractices. The higher the risk score attained, the more cumulative food safety errors made or the fewer control measures implemented.
- The reliability of this observational technique has been previously determined and a reproducibility analysis has shown that key food safety behaviors implemented during food preparation sessions in the model kitchen are representatives of practices implemented in the home
- No statistical analysis was conducted. Descriptive statistics were given for the food consumer groups with regards to the food safety risk scores. Percentages were given for cross-contamination behaviors.

Data Collection Summary:

Timing of Measurements

- One-time measure for food preparation
- All raw food products used were sampled for presence or absence of *Salmonella* and *Campylobacter* before each food preparation session
- Model domestic kitchen was cleaned using a validated protocol prior to each food preparation session; the effectiveness of the cleaning protocol was routinely verified
- The model kitchen was sampled immediately after participants had completed individual food preparation sessions
- Time of year was not given.

Dependent Variables

- Food safety risk scores representing all observed food safety malpractices
- Food safety risk scores representing all observed cross-contamination malpractices
- Failure to implement adequate hand-washing and hand-drying behaviors

- Failure to implement safe chopping board and knife usage
- Additional potential cross-contamination malpractices.

Independent Variables

- Adults more than 60 to 75 years of age
- Mother with child aged less than 10 years
- Single male adult aged (18 to 28 years)
- Microbial contamination sites included all steps and items involved in the food preparation.

Description of Actual Data Sample:

- *Initial N:* Unclear as to actual number of participants
  - Table 1 and 3 list N=10 for each of the consumer groups
  - Table 2 lists N of six, nine and nine, for a total sample N=24
- *Attrition (final N):* As above
- *Age:*
  - Adults more than 60 to 75 years of age
  - Mothers with at least one child aged less than 10 years
  - Single male adults aged 18 to 28 years
  - No mean, standard deviations (SD) or ranges were given for ages within each consumer group
- *Location:* Food Research and Consultancy Unit in Cardiff, Wales.

Summary of Results:

Key Findings

- A comparison of total risk scores and risk scores representing cross-contamination behaviors show that 80% to 86% of all unsafe food-handling behaviors implemented during food preparation sessions were associated with cross-contamination actions
- In the model domestic kitchen, 29% of food preparation sessions resulted in positive *Campylobacter* isolations from prepared chicken salads and cleaning materials and food contact surfaces. Furthermore, the specific *Campylobacter* strains isolated from the prepared chicken salads were the same as the strains isolated from the raw chicken pieces, indicating cross-contamination during food preparation
- Of the 30 retail, raw chicken pieces used in meal preparation sessions, 80% (24 of 30) were naturally contaminated with *Campylobacter* and six percent (two of 30) were naturally contaminated with *Salmonella*. Two pieces were positive for both bacteria. No other foods used in meal preparations were contaminated with either pathogen
- Observation results also indicated that 79% of participants failed to use separate parts of the kitchen for preparation of raw chicken and RTE foods. Furthermore, no participants prepared all RTE foods (salad vegetables, cooked ham) before handling raw chicken.
- Three participants, including one older male, one older female and one single young male adult, produced *Campylobacter*-positive end products and validated observations confirmed that chicken pieces in such end products were not undercooked
- Three more participants contaminated only one item per food preparation session (kitchen surface wipers) and one participant (an older male) contaminated three separate areas (work surface, dishcloth and a hand towel)
- A larger proportion (67%) of older adults aged more than 60 to 75 years contaminated end

products or the model kitchen with *Campylobacter* than mothers with young children (11%) and young male adults (22%)
- *Campylobacter* was isolated from the kitchen work surface, dishcloth (scourer), hand towel, dishcloth (fine weave cloth), chicken and pasta salad (end product) and T-towel
- 56% of positive samples taken after food preparation were dishcloths, T-towels and hand towels.

Author Conclusion:

Data obtained from this study can used for exposure assessment, risk management and in the development of consumer risk communication strategies.

Reviewer Comments:

- *Unclear as to actual number of participants*
- *No statistical analysis was completed.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	???

2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	No
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	???
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	???
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	No
4.1.	Were follow-up methods described and the same for all groups?	No
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	No
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes

5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	Yes
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	No
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	N/A
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	N/A
7.6.	Were other factors accounted for (measured) that could affect outcomes?	???

7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	No
8.1.	Were statistical analyses adequately described and the results reported appropriately?	No
8.2.	Were correct statistical tests used and assumptions of test not violated?	N/A
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	No
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	N/A
8.6.	Was clinical significance as well as statistical significance reported?	No
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes